THE WEATHER AND CIRCULATION OF MARCH 1952[1]

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The circulation patterns of March 1952 were characterized by extreme deviations from the normal at both sea level and 700 mb. The Pacific High was abnormally strong, with positive anomalies at 40° N., 150° W. of 420 feet at 700 mb. (fig. 1) and 11 mb. at sea level (Chart XI, inset), and the anticyclone was displaced northwest of its normal position. The westerlies in the northeastern Pacific were much stronger than normal, as indicated by the line of equal height departure from normal in figure 1. This strong current underwent considerable diffluence or spreading as it crossed the mountains of western North America. The major portion veered southeastward across the abnormally deep trough with large horizontal tilt in western and central United States.

It has long been recognized that the position and intensity of the eastern Pacific High has a profound effect upon the weather and circulation of North America. To illustrate this, figure 2 has been reproduced. This figure represents an average of ten 700-mb. 5-day mean charts

[1] See Charts I–XV following p. 58 for analyzed climatological data for the month.

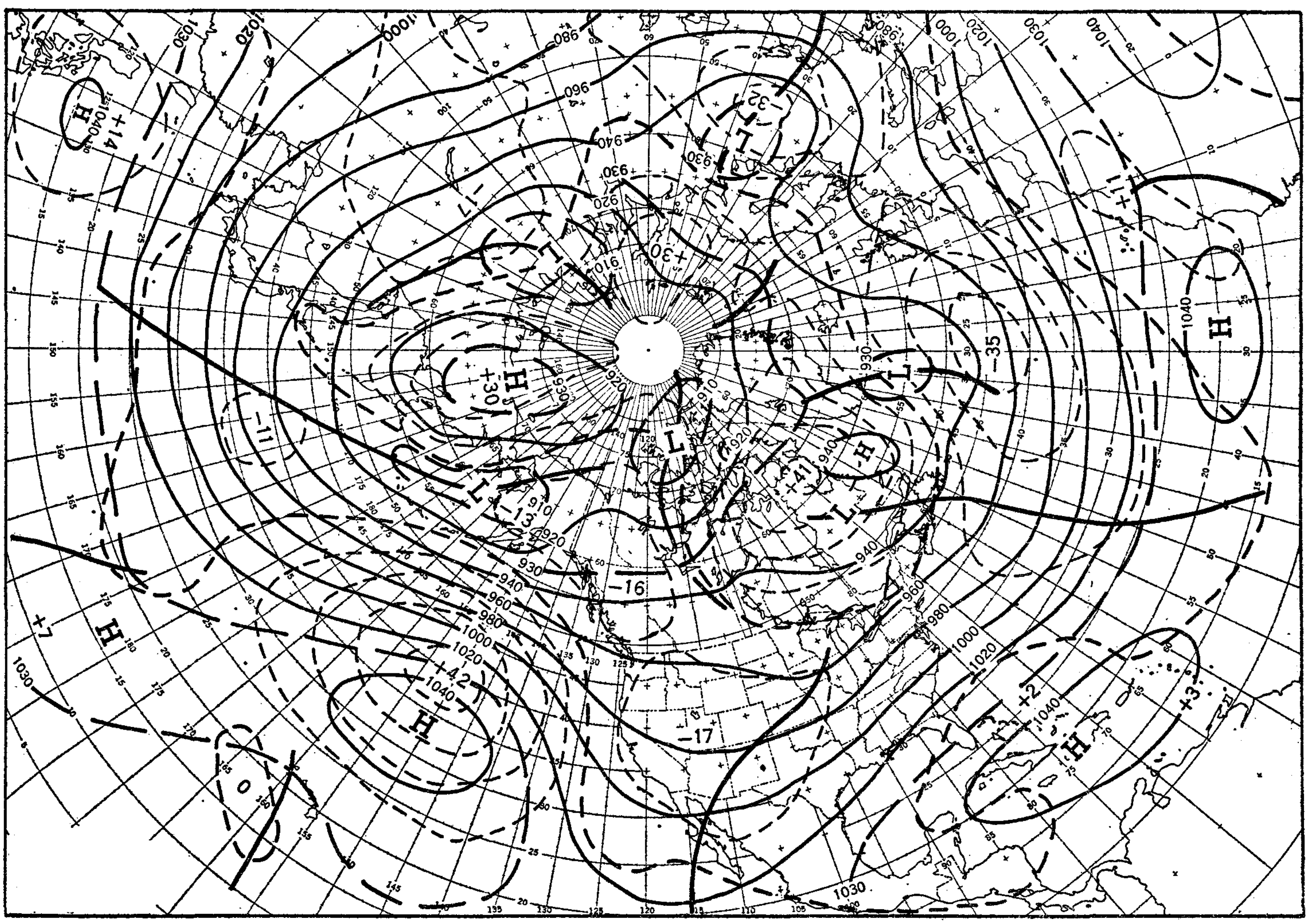


FIGURE 1.—Mean 700-mb. chart for the 30-day period March 1–30, 1952. Contours at 200-ft. intervals are shown by solid lines, intermediate contours by lines with long dashes, and 700-mb. height departure from normal at 100-ft. intervals by lines with short dashes with the zero isopleths heavier. Anomaly centers and contours are labeled in tens of feet. Minimum latitude trough locations are shown by heavy solid lines.

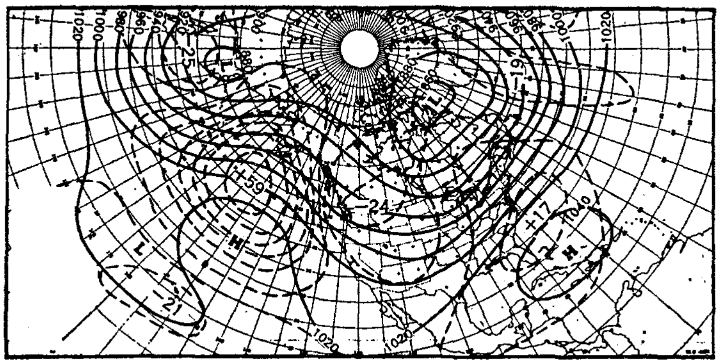


FIGURE 2.—Mean 700-mb. chart for the 10 cases of 5-day mean maps with the largest positive height anomaly at 40° N. and 150° or 160° W. during the past 6 winters. Contours at 200-ft. intervals are shown by solid lines and 700-mb. height departures from normal at 100-ft. intervals by dashed lines. Anomaly centers and contours are labeled in tens of feet.

taken from six past winter seasons, each chart of which had very large positive height anomalies at 40° N. and either 150° or 160° W. It is hoped that such a chart gives an indication of the interrelationship between the circulation of the eastern Pacific area and that of other areas of the Northern Hemisphere. Notable features of figure 2 are the deep trough and below-normal heights in western United States, the well-marked ridge and above-normal heights in eastern United States, and the low center and below-normal heights in northeastern Canada. These simultaneous interrelationships are not confined to the extreme cases selected for figure 2. For example, there was a correlation of +0.57 between the anomalies of 700-mb. height at 40° N., 150° W. in the eastern Pacific and 35° N., 75° W. near Cape Hatteras for all winter months from 1945 to 1950 [1]. This tendency for symmetry or a uniform wave structure in the atmosphere may provide the mechanism for the northward transport of momentum and vorticity throughout eastern North America to compensate for that which is transported southward in the West around the Pacific anticyclone.

The mean 700-mb. circulation observed during March 1952 closely resembled the idealized pattern shown in figure 2 in most of the eastern Pacific and western North America. On the other hand, this month's circulation pattern departed drastically from the average pattern of figure 2 throughout eastern North America and the Atlantic. Positive anomalies of 400 ft. at 700 mb. and 14 mb. at sea level were observed at 65° N., 65° W. in northeast Canada where a deep Low appears in figure 2. This is one of the largest anomalies recorded in the last 20 years on a monthly mean chart in this area. These positive anomalies extended eastward throughout the northern portions of the Atlantic resulting in a southward displacement of the Icelandic Low, as indicated by large negative anomalies in the central Atlantic (350 ft. at 700 mb. and 12 mb. at sea level at 45° N., 30° W.). Negative anomalies also extended into the eastern United States where figure 1 shows a positive anomaly center. Thus a blocking or low index type of circulation, with the principal band of westerlies displaced abnormally far south, existed throughout eastern North America, the north Atlantic, and eastward for thousands of miles across Eurasia. It is believed that this blocking condition was instrumental in preventing the occurrence of large positive anomalies in southeastern United States in harmony with those observed in the eastern Pacific.

The cyclone tracks observed during the month (Chart X) reflect the steering influence of the large scale circulation pattern. Storms were virtually absent in the regions of large positive anomaly and concentrated in the regions of negative anomaly. Migratory daily storms which moved northeastward across the Pacific were steered around the periphery of the Pacific anticyclone and intensified in the Gulf of Alaska. Many of these storms plunged southeastward through western North America into the mean trough in southwestern United States. From here the principal track extended across the central Great Plains, Ohio Valley, and Middle Atlantic States, *well south of the normal position. This southward* depression of the principal storm track, together with the unusually low frequency of storminess in eastern Canada, further illustrates the blocking type of circulation which prevailed in eastern North America during March.

The high frequency of cyclones in the United States produced heavy precipitation over most of the country. Much of this fell in the form of snow (Charts IV and V). In the Sierra Nevada and Rocky Mountains a near-record snow pack was recorded. Blizzard conditions were frequent in north central United States, where some roads were blocked and it was necessary to supply isolated families and cattle with food by airlift operations. Precipitation was also quite abundant throughout eastern United States in the abnormally strong southwesterly flow ahead of a deep mean trough at 700 mb. At times, brief intrusions of maritime tropical air in advance of migratory storms produced destructive thunderstorms and tornadoes in the South.[2]

In southern portions of Texas and New Mexico there was a marked deficiency of precipitation. This condition accompanied unusually strong dry foehn winds and might be considered a good example of "rain shadow". Throughout this area numerous damaging dust storms were reported. Precipitation was also generally subnormal along the northern border of the United States where storms were less frequent than usual.

The anomalies of surface temperature shown in Chart I indicate that cold weather prevailed over most of the United States. The most extreme departures were found in the West behind the upper level mean trough and in the region of the lowest height anomalies and were produced by an almost uninterrupted flow of cold air from the northern Pacific reinforced at intervals by Canadian Polar air masses. Sub-zero minima occurred

[2] For further details see adjoining article by Carr.

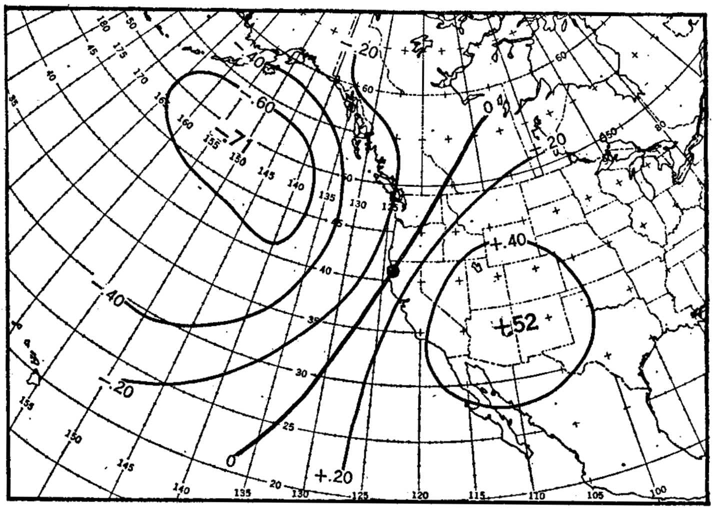


FIGURE 3.—Correlation field between 5-day mean surface temperature anomaly in winter at Eureka, Calif. (location shown by heavy black circle) and simultaneous 5-day mean 700-mb. height anomaly at standard intersections of latitude and longitude. The lines of equal correlation coefficient are drawn at intervals of .2. Centers of maximum and minimum correlation are labeled with highest observed coefficient value.

on several mornings in the Northern Rockies, and the daily minimum temperature record for March was broken at the Salt Lake City Airport. Previous studies [2] have shown that temperatures throughout the United States west of the Rocky Mountains are dependent on the 700-mb. height anomalies in the northern Pacific and Great Basin areas. For example, a high degree of correlation exists between the surface temperature anomaly at Eureka, Calif. and the 700-mb. height anomalies in these two widely separated regions, as illustrated in figure 3. Since the centers of highest correlation in figure 3 are in approximately the same position as the centers of 700-mb. height anomaly in figure 1, it is reasonable to expect that the circulation pattern of March 1952 would give cold weather in western United States.

In the northern central portions of the United States the easternmost extension of the cold temperature anomalies approximates the longitude of the mean 700-mb. trough line. This is a common relationship, with cold anomalies behind a mean trough and warmer anomalies in front of the trough line. At middle and low latitudes the cold anomaly boundary was considerably farther eastward than the trough line. This often happens when the trough has a large tilt from northeast to southwest with a broad area of cyclonic curvature ahead of the trough. In these cases the below-normal temperatures frequently extend a considerable distance ahead of the mean 700-mb. trough line.

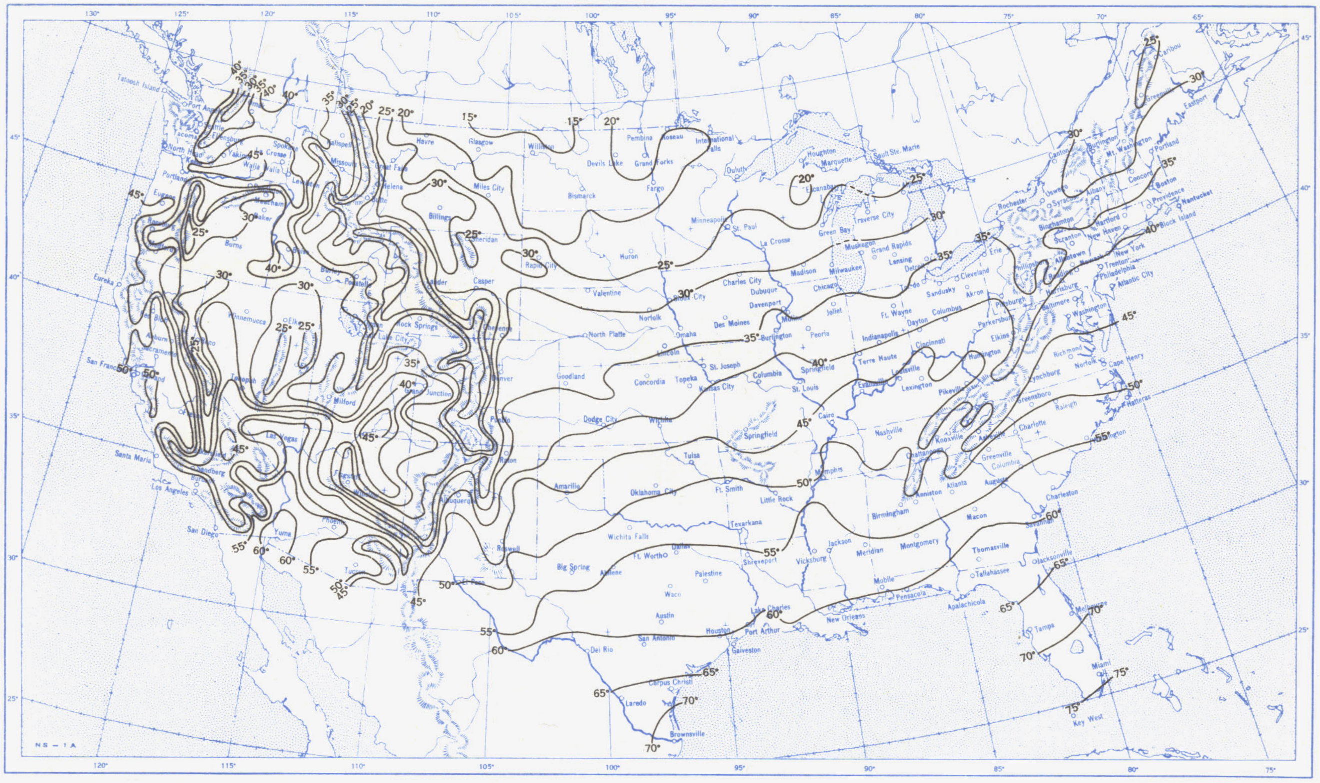
In the eastern United States temperatures averaged a few degrees above normal. Warm weather in the Northeast was associated with a higher than normal frequency of onshore winds from the Atlantic Ocean which is warmer than the continent during March. The area of above-normal temperatures in the Southeast was associated with a ridge at 700 mb. along the East Coast. Although this ridge was weaker than normal, it was strong enough relative to the trough in the West to allow the advection of some warm maritime air masses into southeastern United States.

This month's circulation patterns and the associated anomalies were relatively extreme and persistent. They were essentially a continuation of patterns which had become established in the second half of the preceding month in connection with the onset of a pronounced index cycle [3].

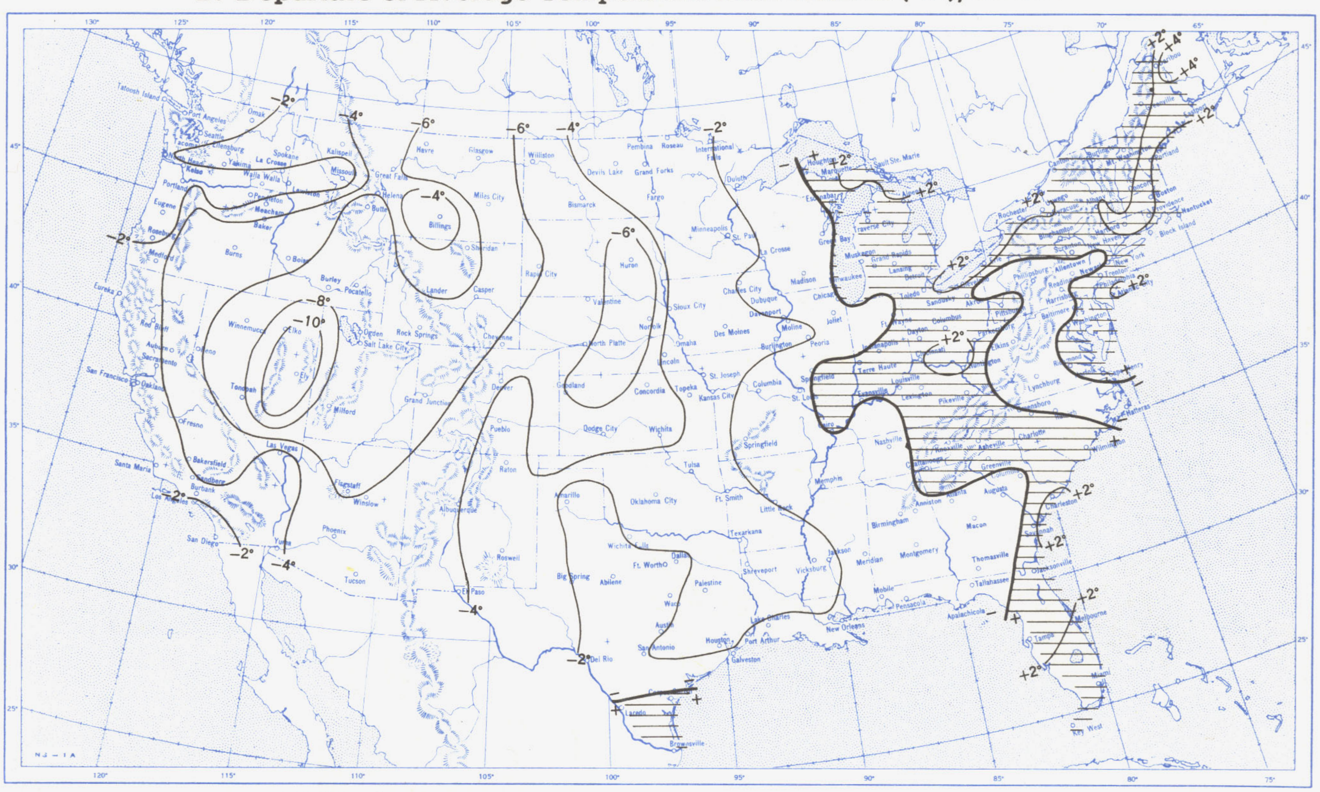
REFERENCES

1. J. Namias, "The Great Pacific Anticyclone of Winter 1949-50: A Case Study in the Evolution of Climatic Anomalies," *Journal of Meteorology*, vol. 8, No. 4, August 1951, pp. 251-261.
2. D. E. Martin and H. F. Hawkins, Jr., "The Relationship of Temperature and Precipitation over the United States to the Circulation Aloft," *Weatherwise*, vol. 3, No. 2, April 1950, pp. 40-43.
3. J. S. Winston, "The Weather and Circulation of February 1951: A Month with a Pronounced Index Cycle," *Monthly Weather Review*, vol. 80, No. 2, February 1952, pp. 26-30.

Chart I. A. Average Temperature (°F.) at Surface, March 1952.



B. Departure of Average Temperature from Normal (°F.), March 1952.

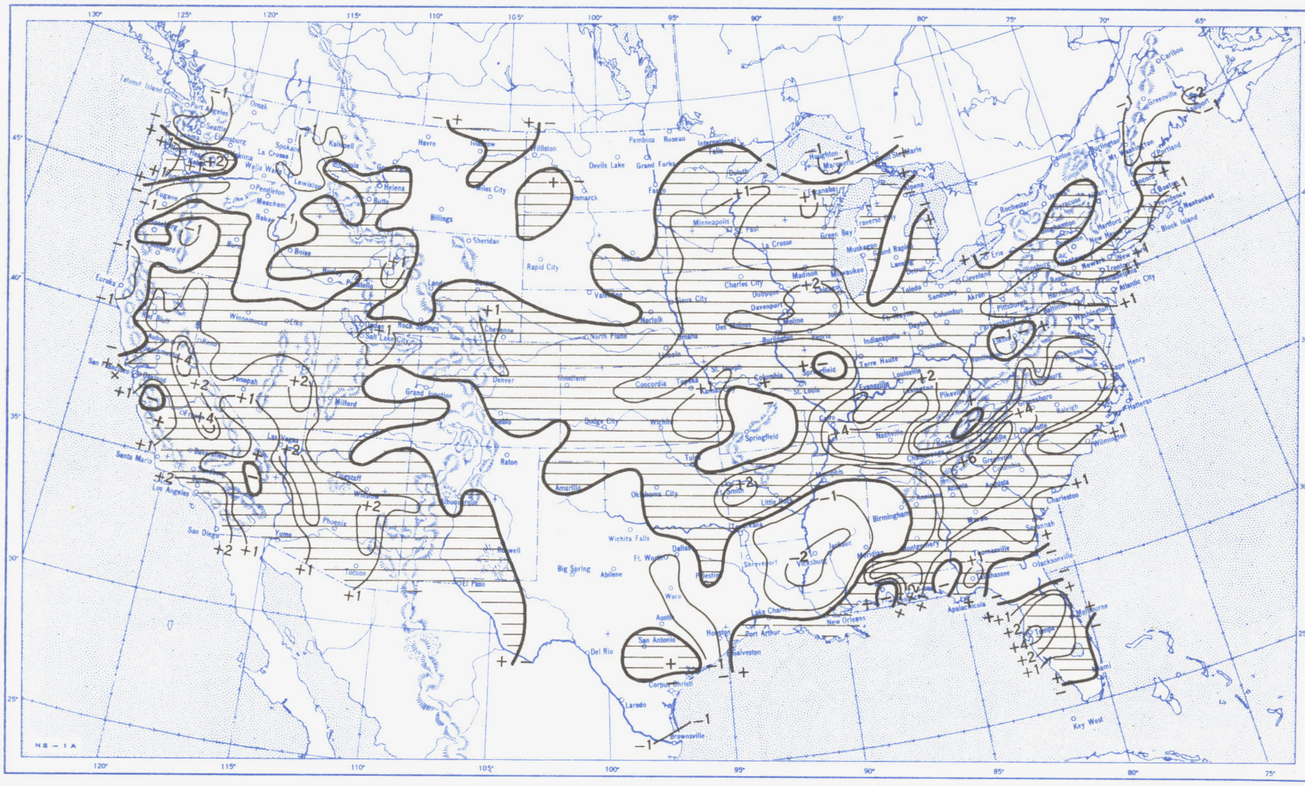


A. Based on reports from 800 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.
B. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.

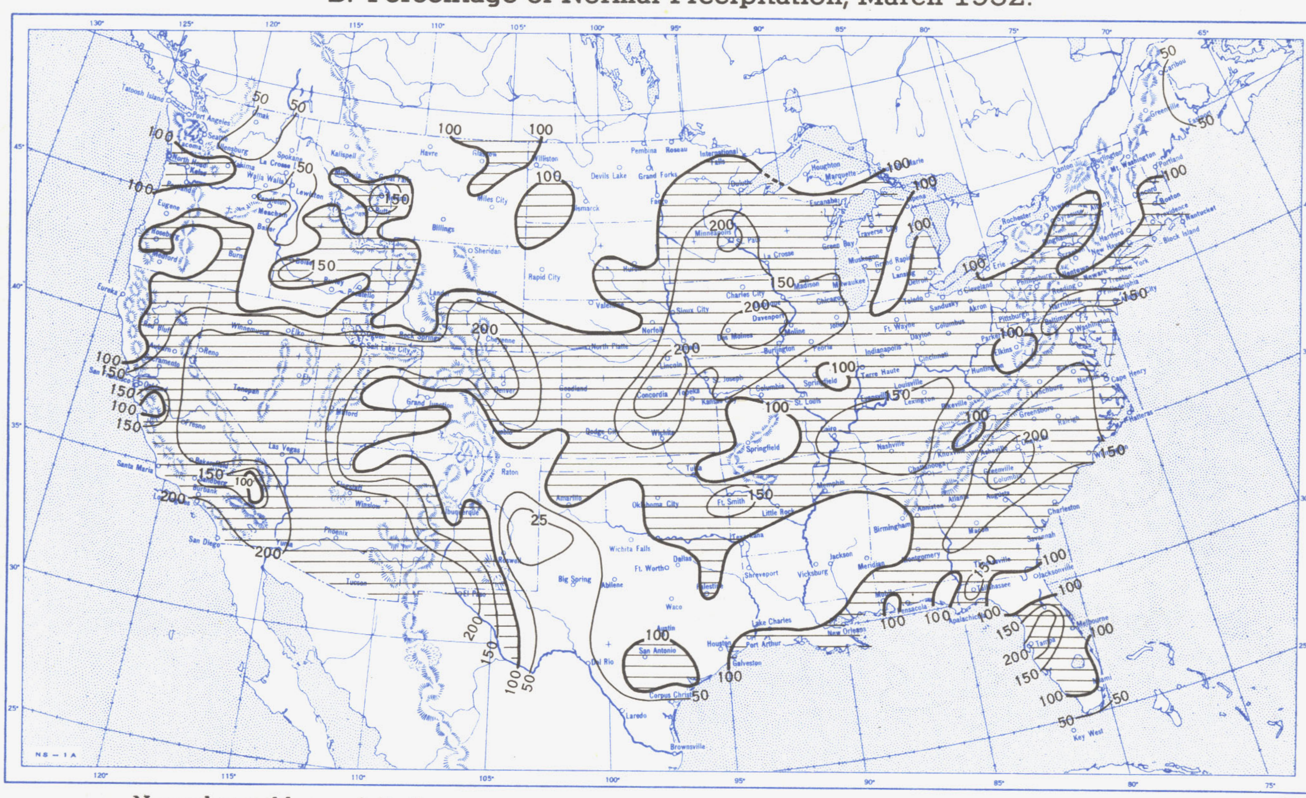
Chart II. Total Precipitation (Inches), March 1952.

Based on daily precipitation records at 800 Weather Bureau and cooperative stations.

Chart III. A. Departure of Precipitation from Normal (Inches), March 1952.



B. Percentage of Normal Precipitation, March 1952.

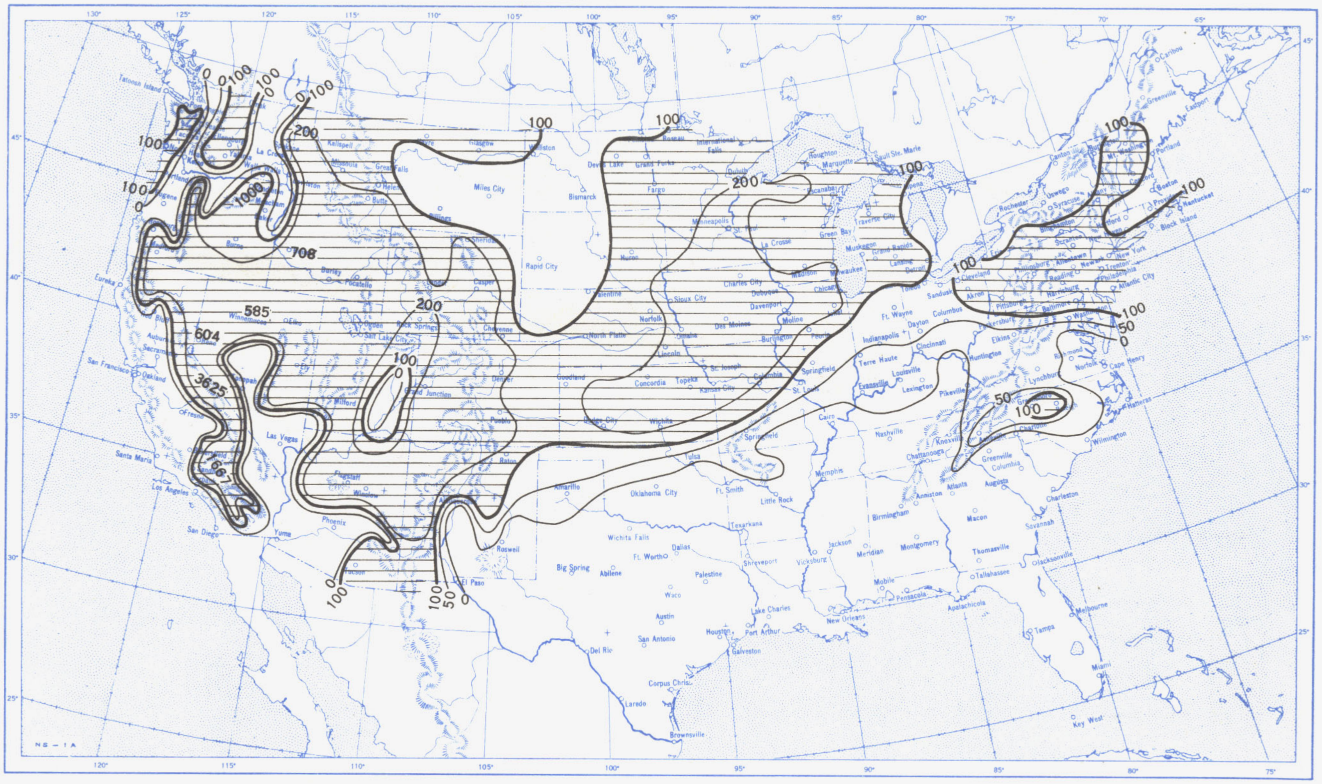


Normal monthly precipitation amounts are computed for stations having at least 10 years of record.

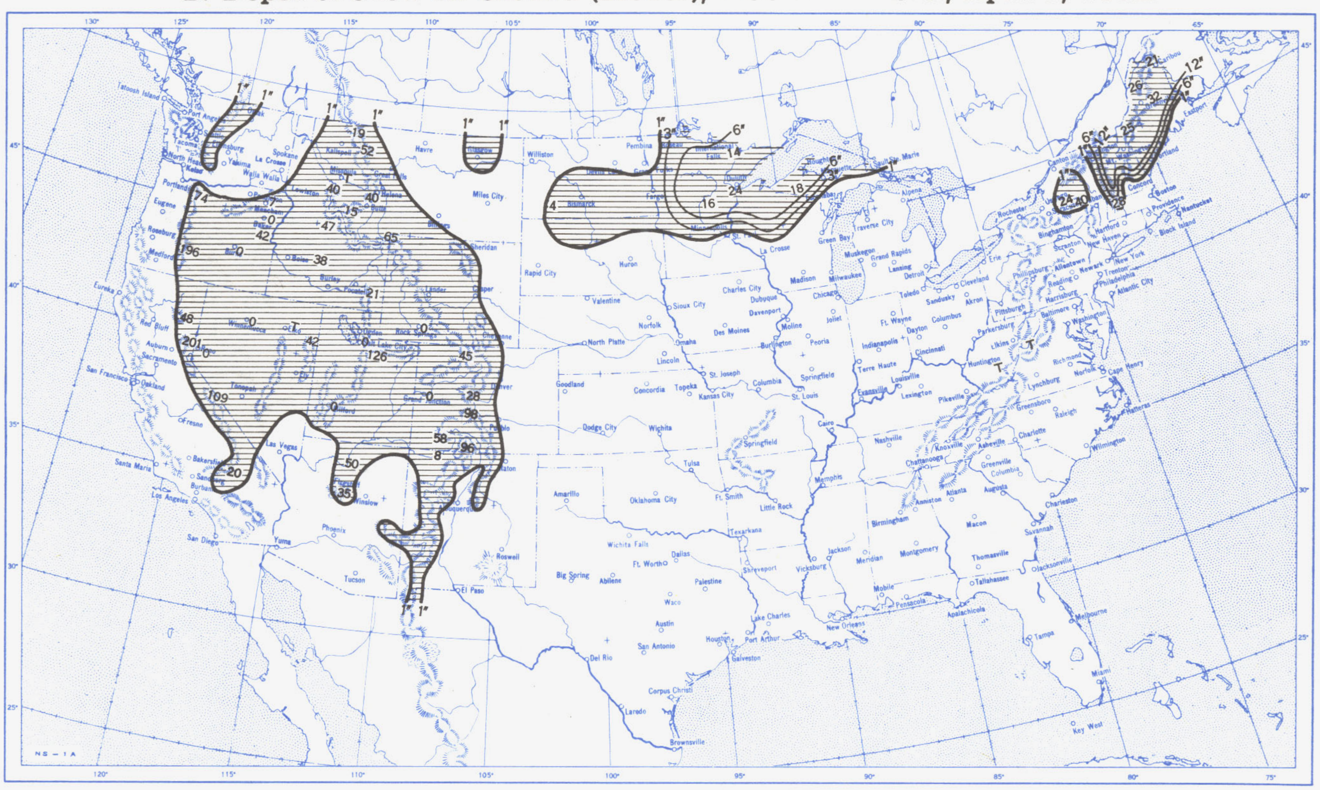
Chart IV. Total Snowfall (Inches), March 1952.

This is the total of unmelted snowfall recorded during the month at Weather Bureau and cooperative stations. This chart and Chart V are published only for the months of November through April although of course there is some snow at higher elevations, particularly in the far West, earlier and later in the year.

Chart V. A. Percentage of Normal Snowfall, March 1952.

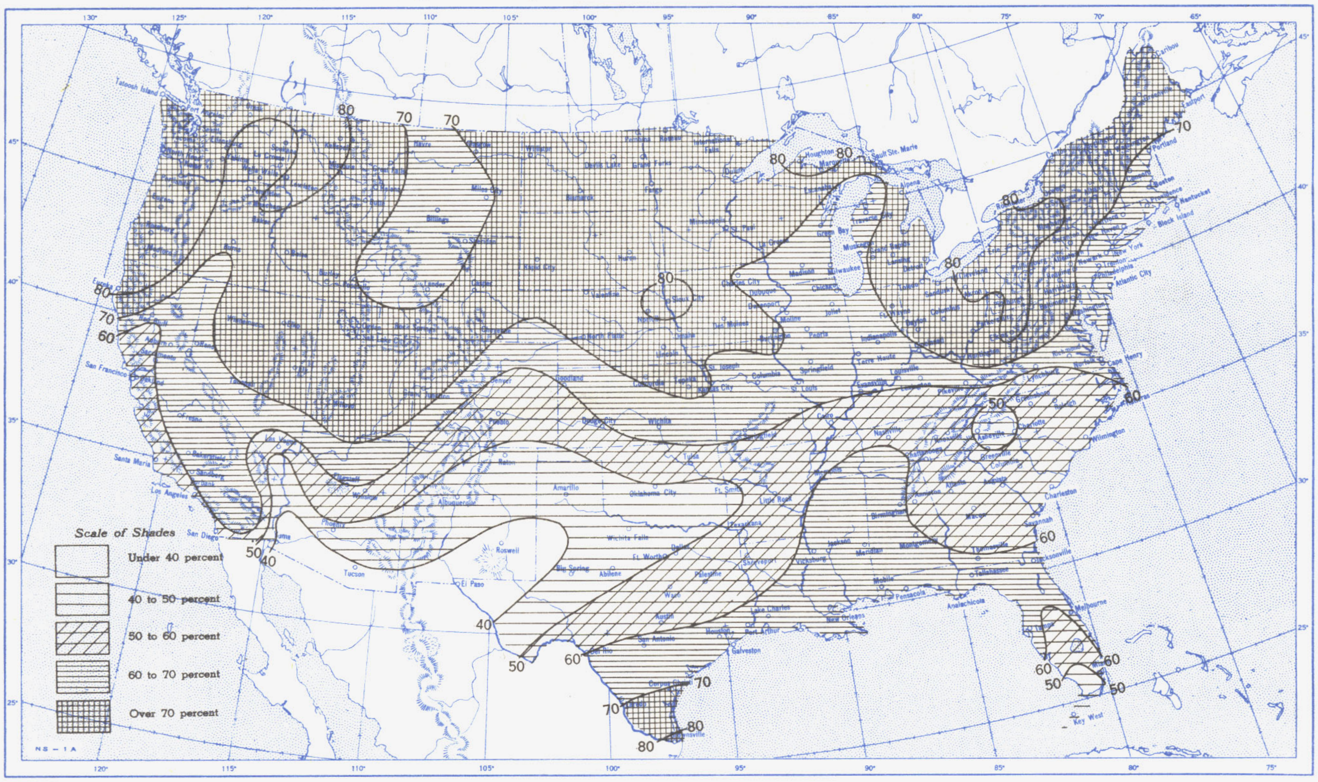


B. Depth of Snow on Ground (Inches), 7:30 a. m. E. S. T., April 1, 1952.

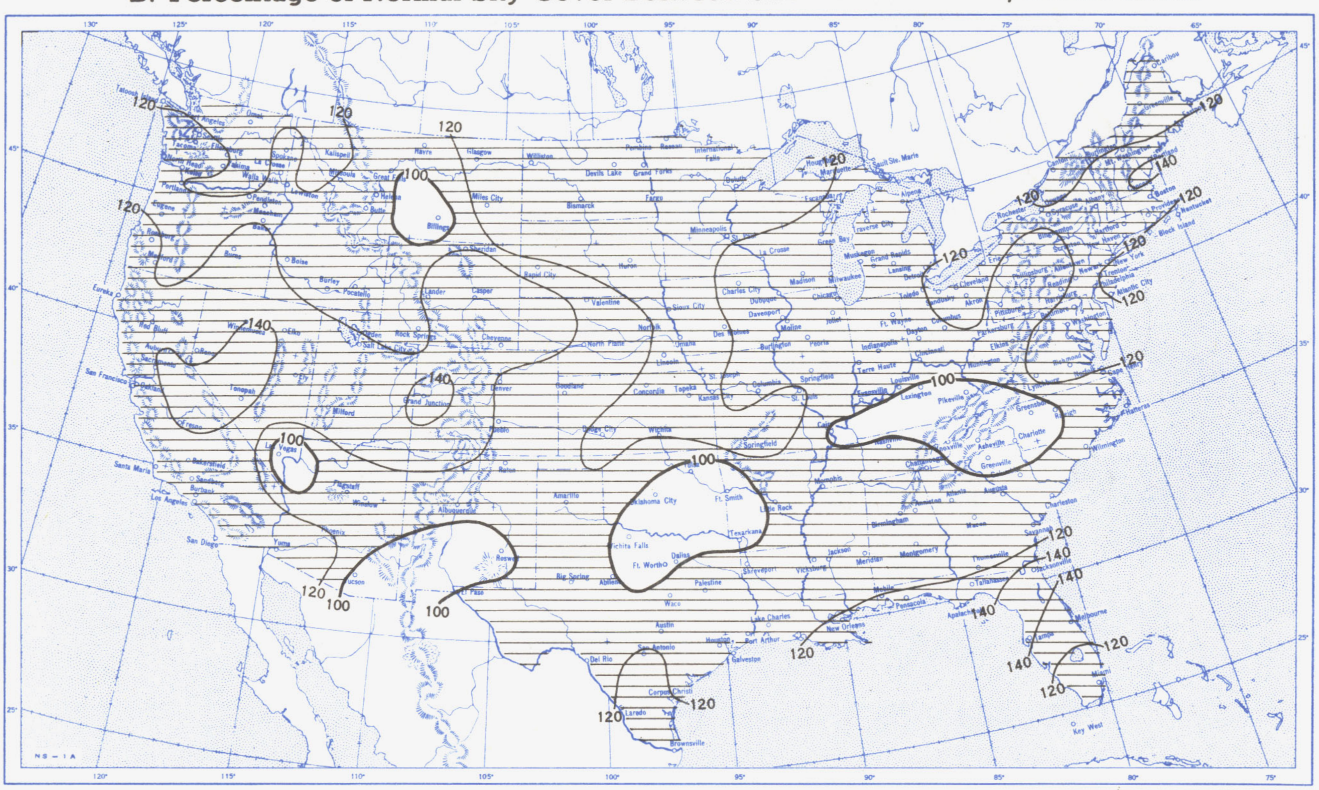


A. Amount of normal monthly snowfall is computed for Weather Bureau stations having at least 10 years of record.
B. Shows depth currently on ground at 7:30 a. m. E. S. T., of the Tuesday nearest the end of the month. It is based on reports from Weather Bureau and cooperative stations. Dashed line shows greatest southern extent of snowcover during month.

Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, March 1952.

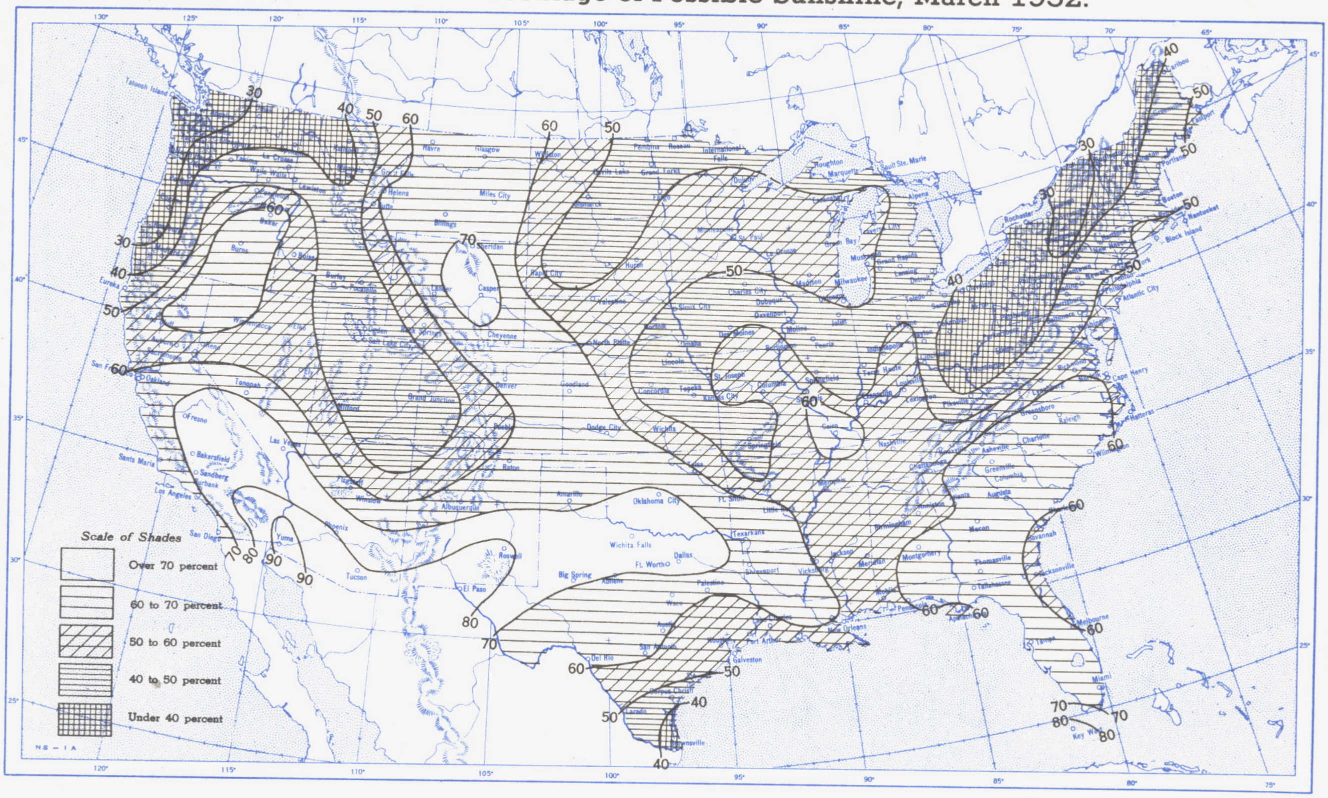


B. Percentage of Normal Sky Cover Between Sunrise and Sunset, March 1952.

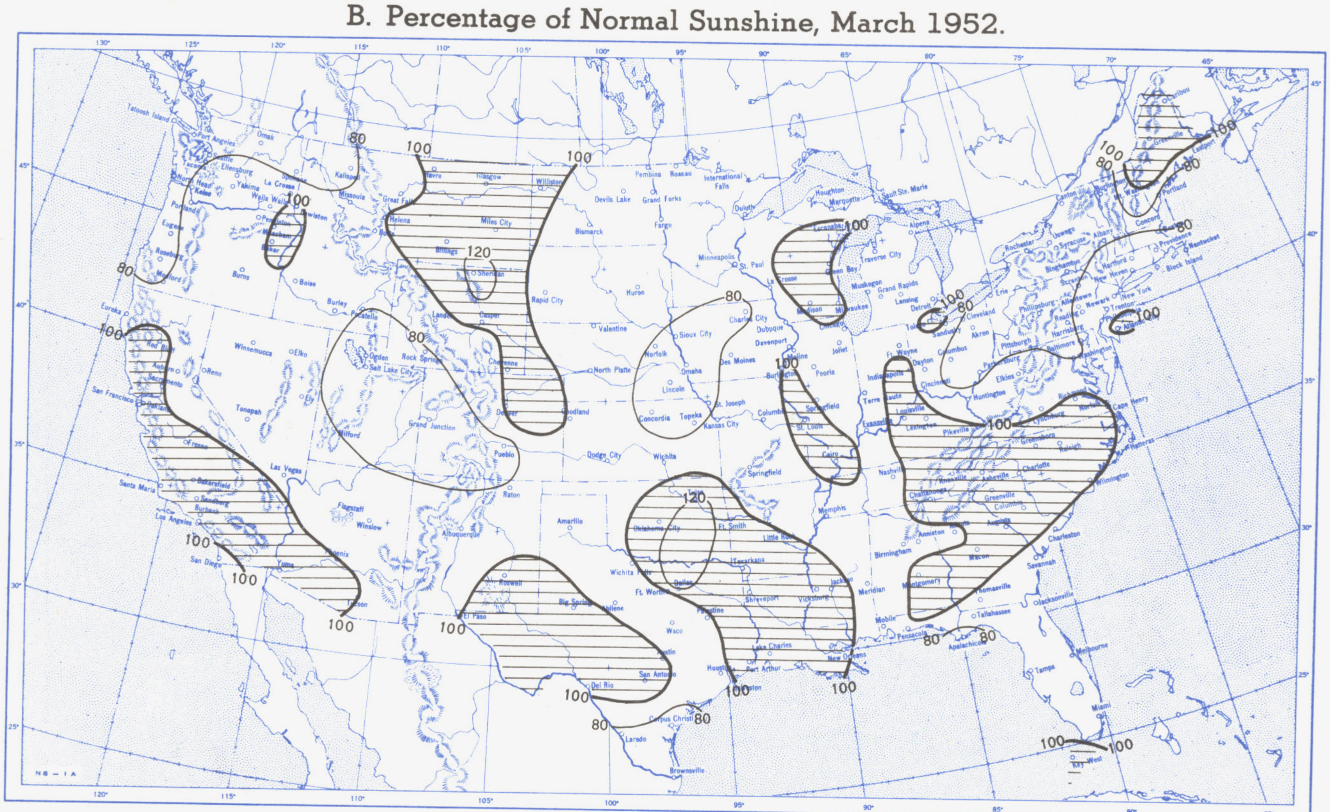


A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

Chart VII. A. Percentage of Possible Sunshine, March 1952.



B. Percentage of Normal Sunshine, March 1952.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, March 1952. Inset: Percentage of Normal Average Daily Solar Radiation, March 1952.

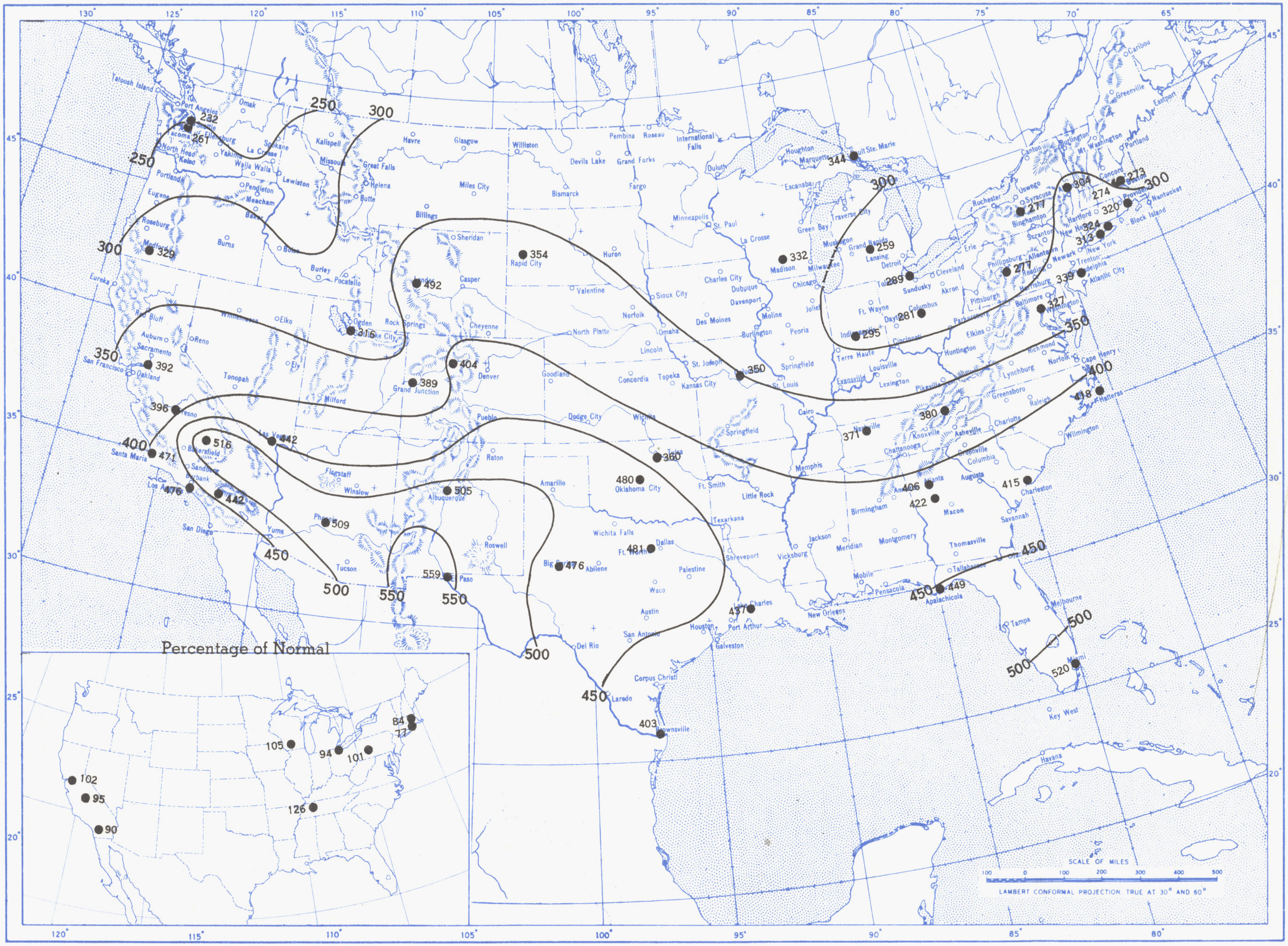
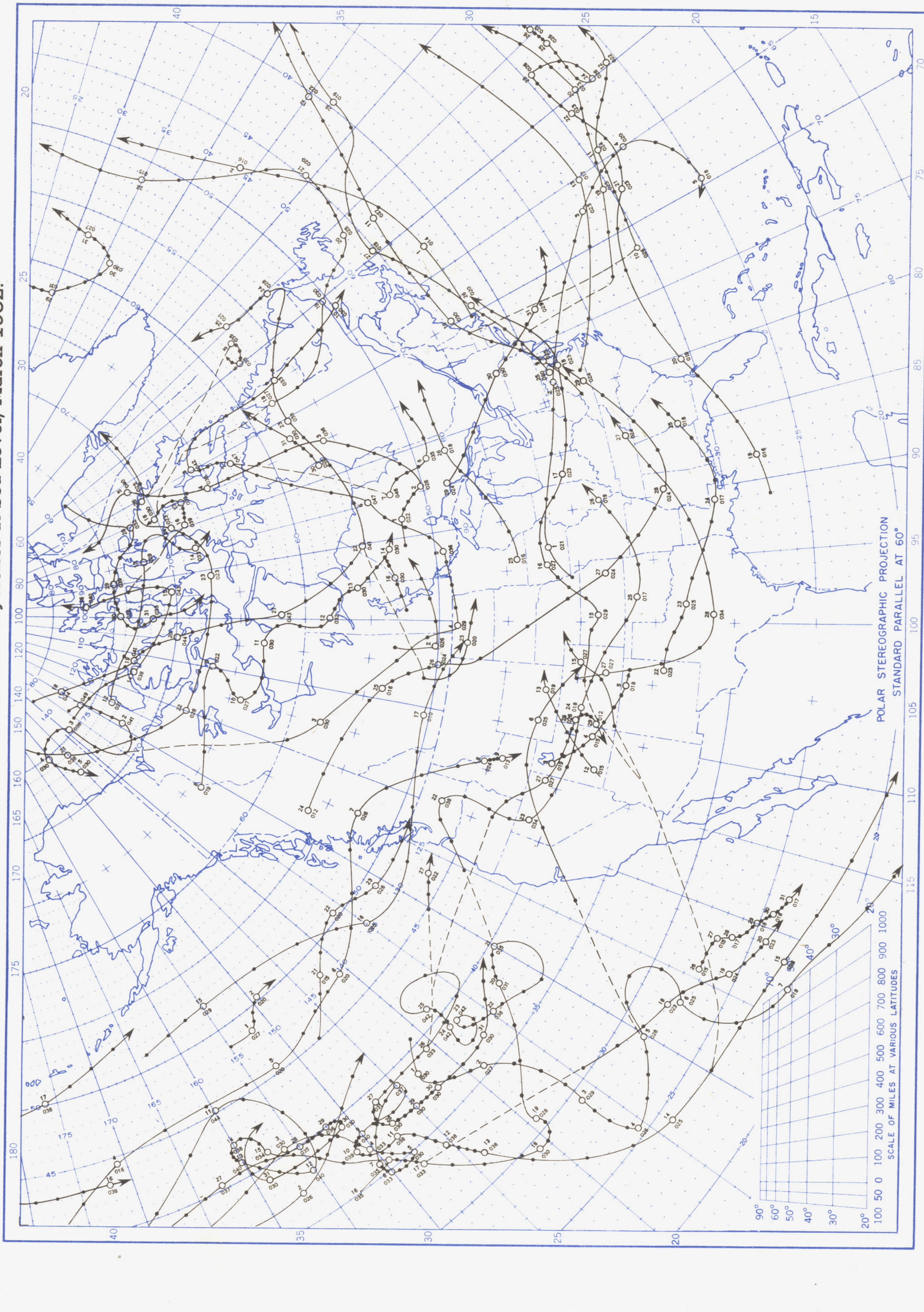


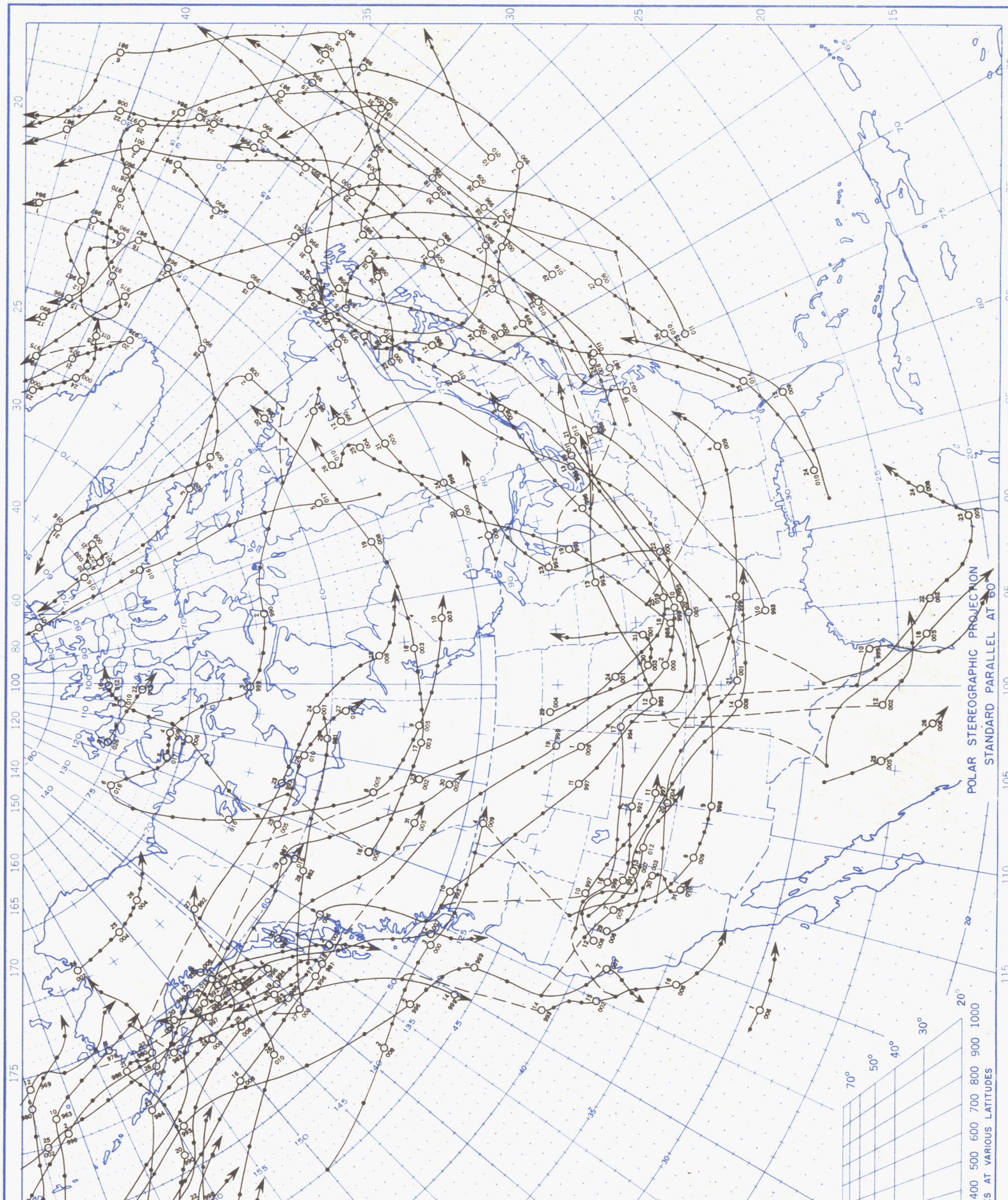
Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm.$^{-2}$). Basic data for isolines are shown on chart. Further estimates obtained from supplementary data for which limits of accuracy are wider than for those data shown. Normals are computed for stations having at least 9 years of record.

Chart IX. Tracks of Centers of Anticyclones at Sea Level, March 1952.



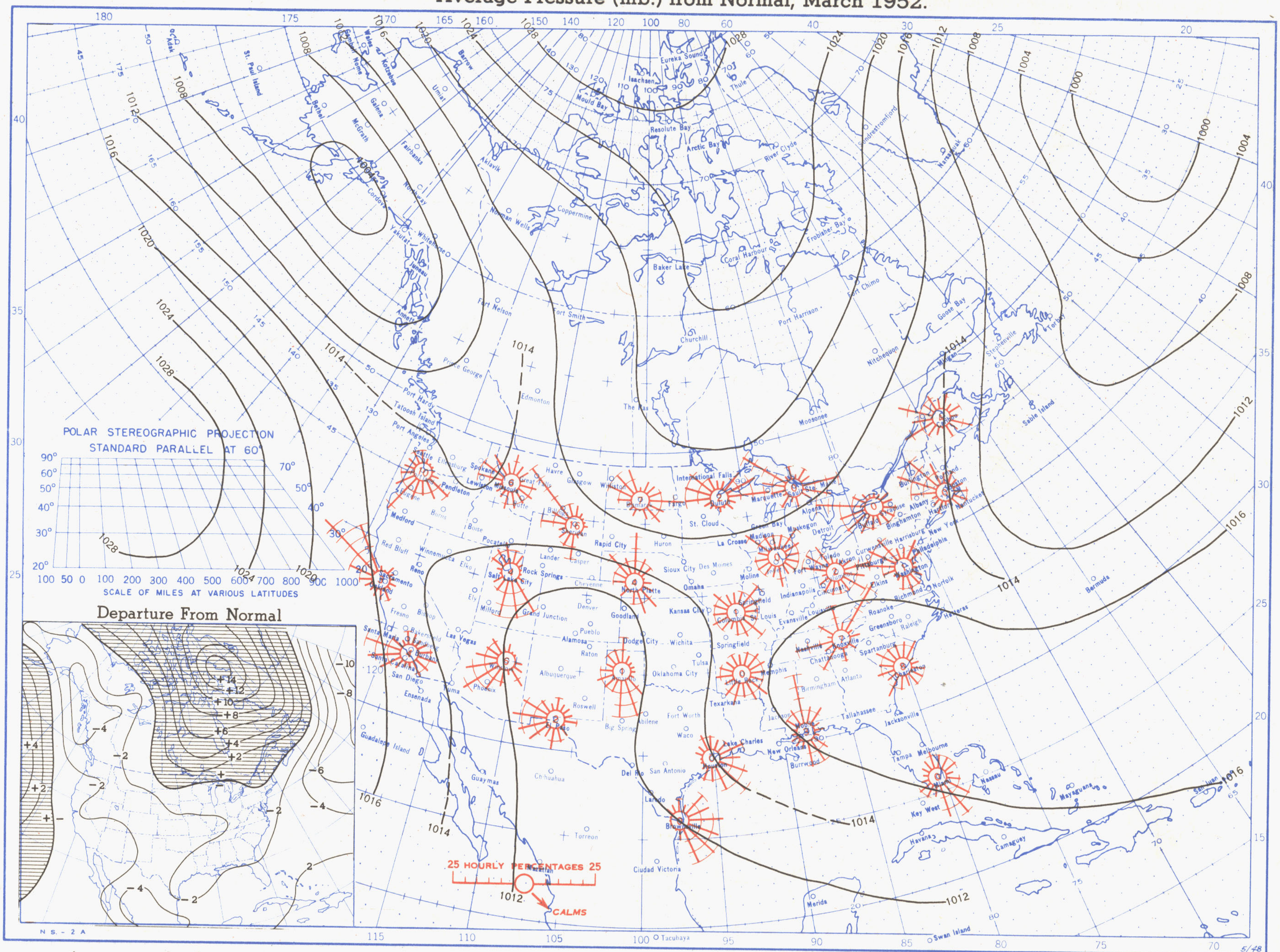
Circle indicates position of center at 7:30 a. m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.

Chart X. Tracks of Centers of Cyclones at Sea Level, March 1952.



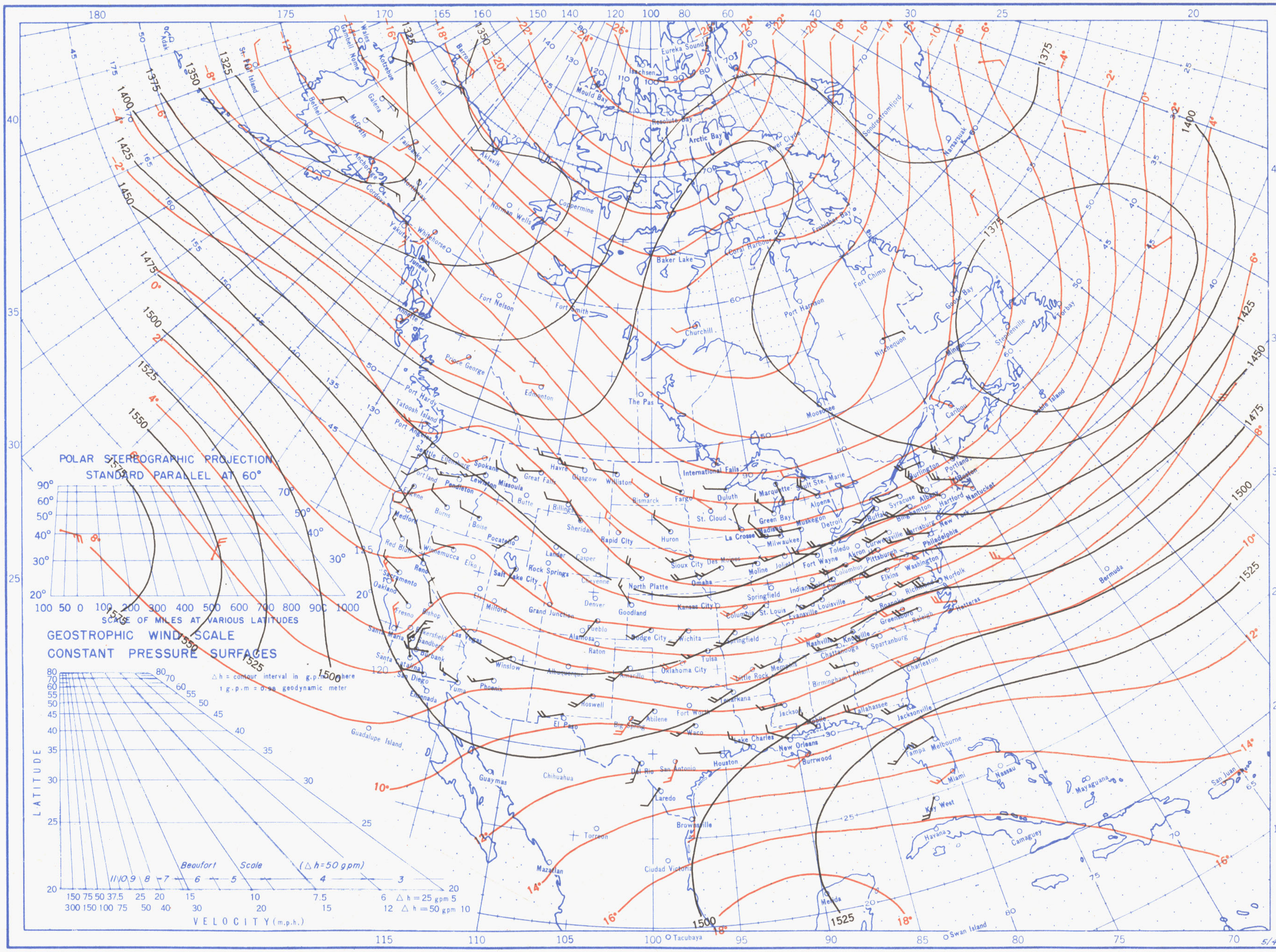
Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, March 1952. Inset: Departure of Average Pressure (mb.) from Normal, March 1952.



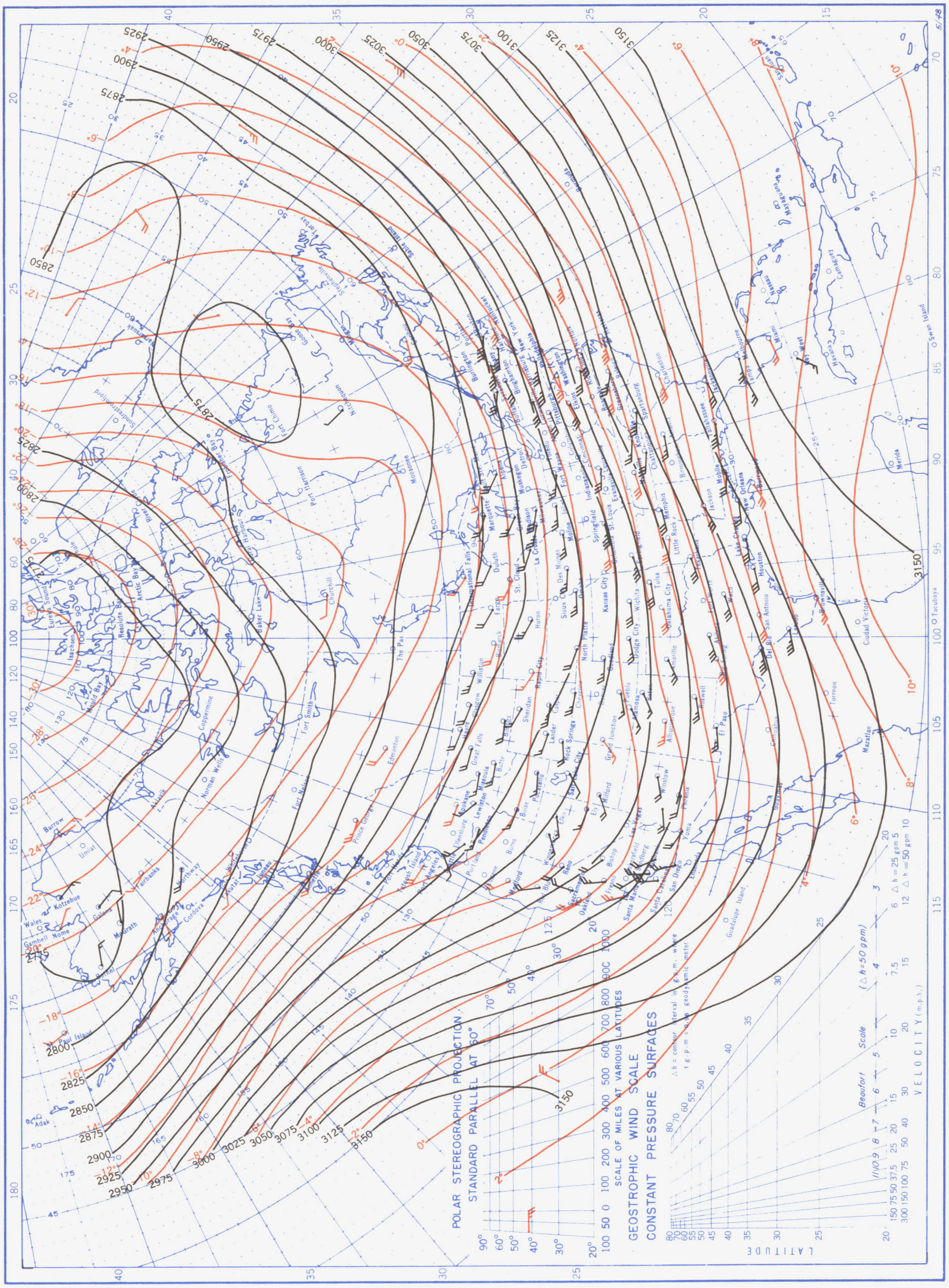
Average sea level pressures are obtained from the averages of the 7:30 a.m. and 7:30 p.m. E.S.T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.

Chart XII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 850-mb. Pressure Surface, Average Temperature in °C. at 850 mb., and Resultant Winds at 1500 Meters (m.s.l.), March 1952.



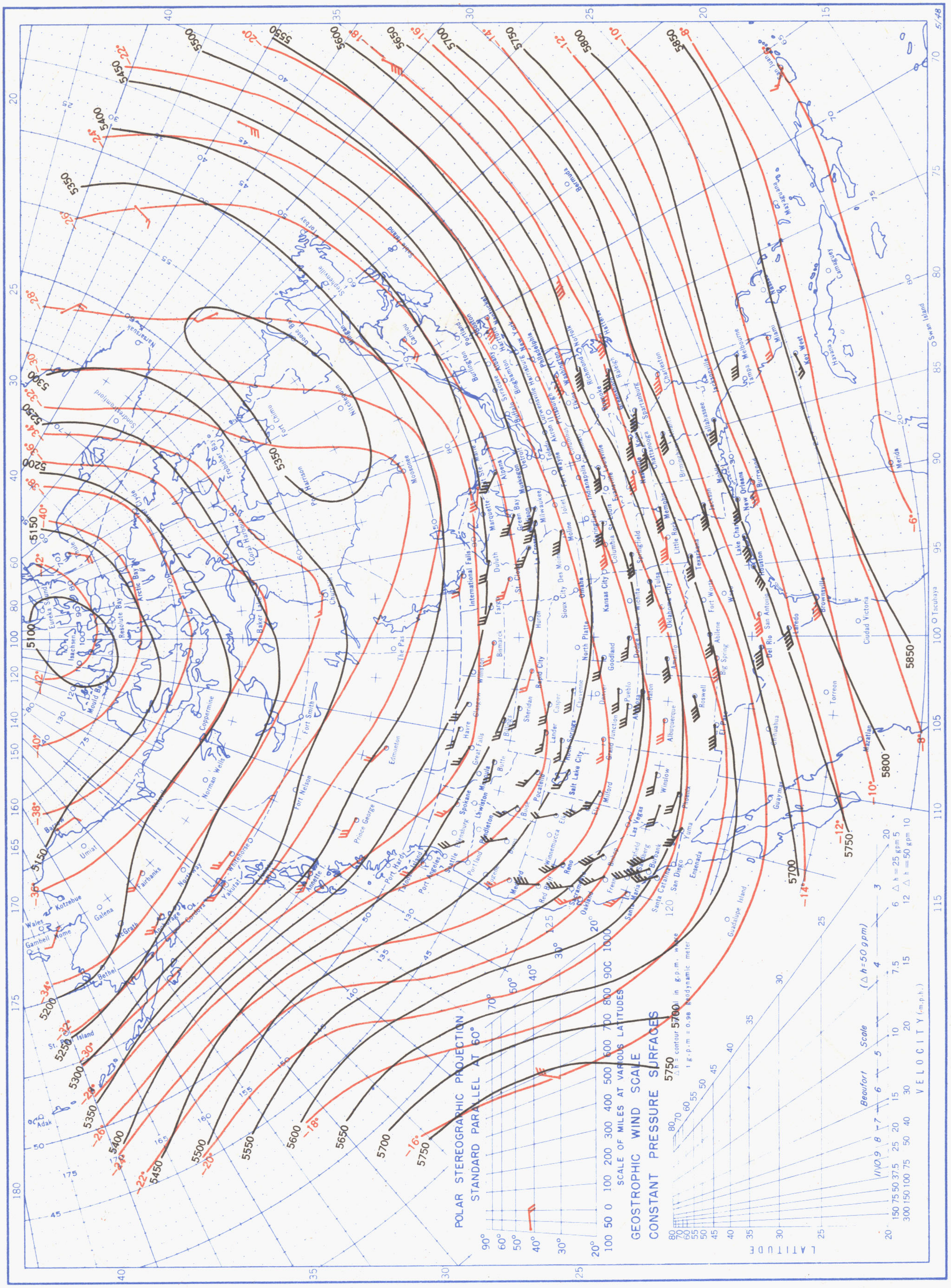
Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T.

Chart XIII. Average Dynamic Height in Geopotential Meters (1 g.p.m.. = 0.98 dynamic meters) of the 700-mb. Pressure Surface, Average Temperature in °C. at 700 mb., and Resultant Winds at 3000 Meters (m.s.l.), March 1952.



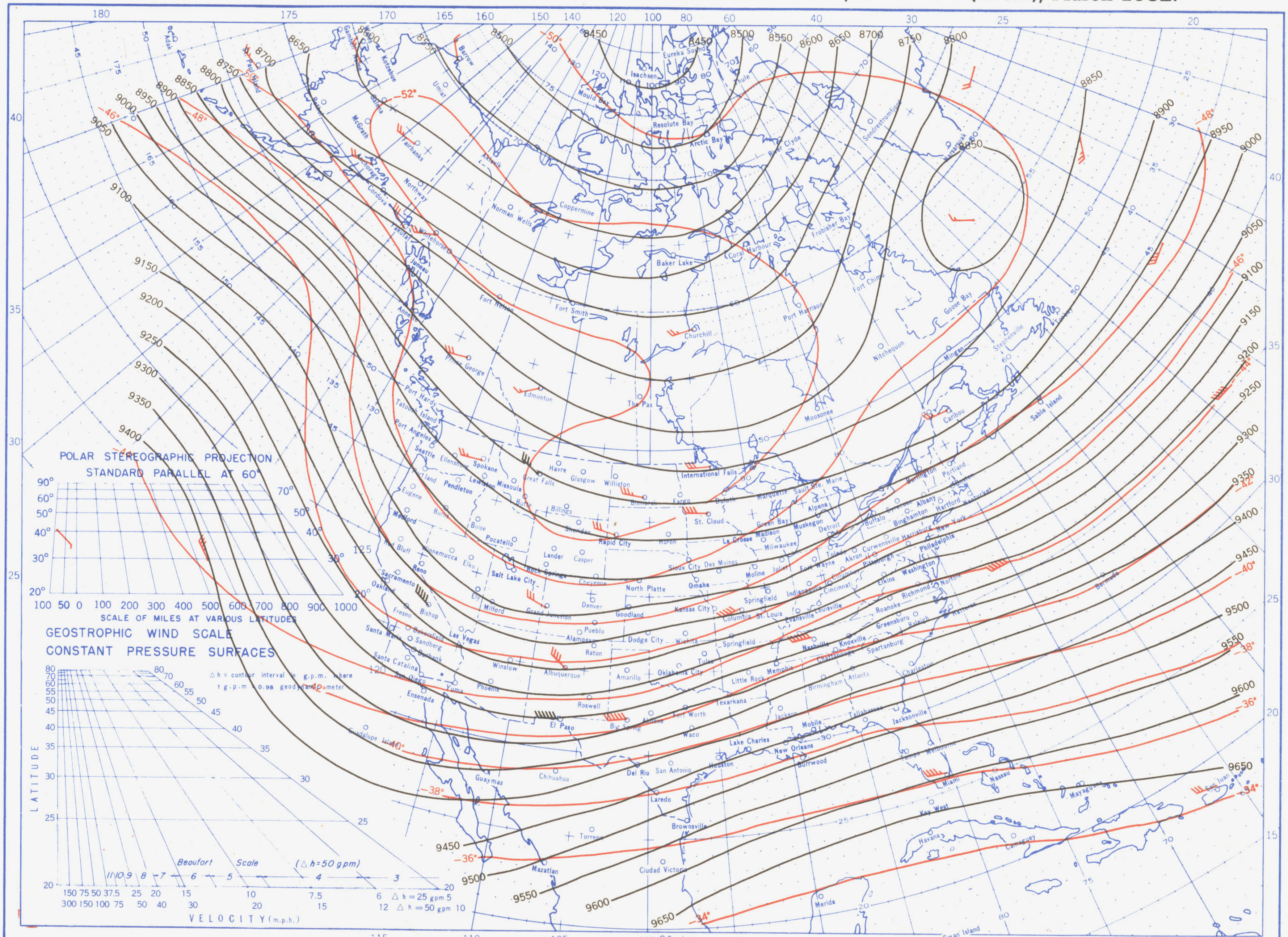
Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T.

Chart XIV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 500-mb. Pressure Surface, Average Temperature in °C. at 500 mb., and Resultant Winds at 5000 Meters (m.s.l.), March 1952.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T.

Chart XV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 300-mb. Pressure Surface, Average Temperature in °C. at 300 mb., and Resultant Winds at 10,000 Meters (m.s.l.), March 1952.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T.